(12) UK Patent Application (19) GB (11) 2 065 782 A

(21) Application No 8037104
(22) Date of filing 19 Nov 1980
(30) Priority data
(31) 2949092
(32) 6 Dec 1979
(33) Fed. Rep. of Germany (DE)
(43) Application published
1 Jul 1981
(51) INT CL³
F04B 37/08
(52) Domestic classification
F1N 3B2
(56) Documents cited
GB 1225608
(58) Field of search
F1N
F4H
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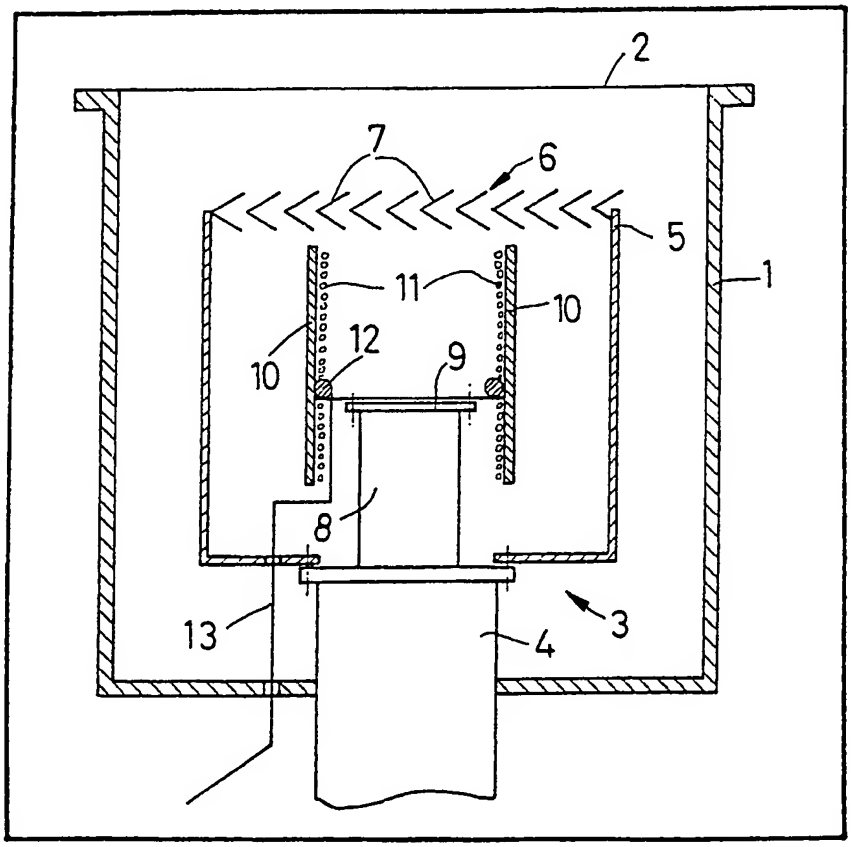
(54) Cryopump

(57) A cryopump comprises condensing surfaces 10 mounted on a cooling head 9. At least one heating wire 12 is provided in the immediate vicinity of the condensing surfaces 10 for regenerating the latter.

If the cooling head 9 is formed by the second stage 8 of a two-stage cryogenic refrigerator 3, then it is not necessary to switch off the refrigerator during the regeneration cycle.



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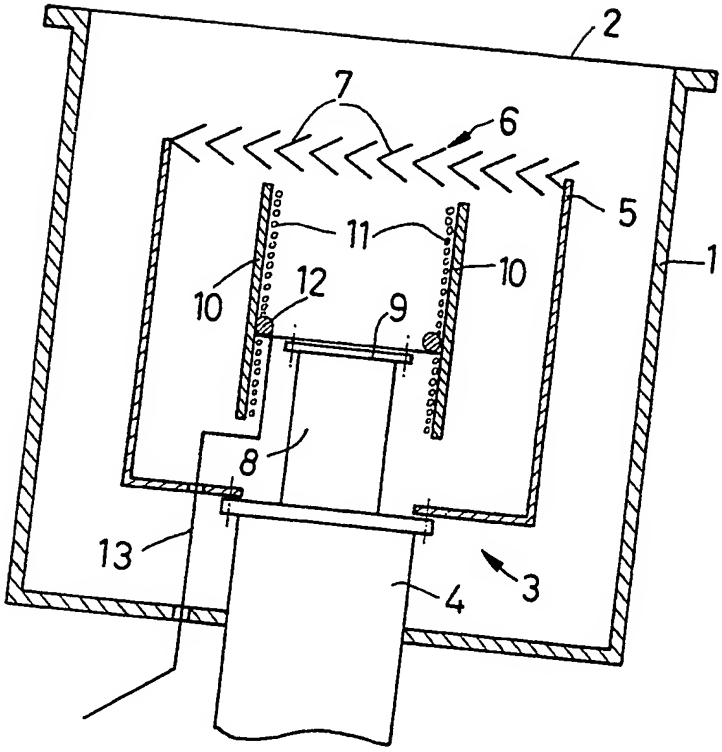

SPECIFICATION

Cryopump

The invention relates to a cryopump. The pumping action of a cryopump is based upon the fact that the gases to be pumped off condense on cooled surfaces. The lower the temperature of the condensing surfaces, the better is the pumping action.

The condensing surfaces can be cooled by using the bath-cooling or evaporator-cooling principle. In recent times, use has been made of cryogenic refrigerators (e.g. as described in GB-PS 1,087,893) which, depending upon the required temperature, can be of single-stage or two-stage construction. The cold source, irrespective of the nature of its cooling, is generally formed as a cooling head with which the condensing surfaces communicate in a manner providing good thermal conductivity. The condensing surfaces are also frequently covered with means to adsorb gases (e.g. active carbon or zeolite), so that the available surface is thereby dramatically increased.

During operation of the cryopump, the gases to be pumped away condense on or are adsorbed by the condensing surfaces. With the growth of the frozen-on layer or of the adsorbed quantity of gas, the pumping action of the condensing surfaces diminishes, so that it becomes necessary to regenerate them. This is achieved, for example, by interrupting the cooling until the temperature of the condensing surfaces has increased to such an extent that the frozen-on or adsorbed gases are released. Thereafter, the cooling process is resumed, so that the condensing surfaces again acquire the required temperature. A regeneration cycle of this kind suffers from the disadvantage that the actual pumping operation has to be interrupted for a lengthy period. Furthermore, it has been found that even after the regeneration of panels, coated with active carbon, by heating up to room temperature, the number of possible cycles preceding the next regeneration treatment always becomes smaller in that a kind of poisoning process takes place.

It has already been proposed to heat the condensing surfaces of a cryopump at a raised temperature, this being done with the aid of heating wires which are brought, from the exterior, on to the housing which contains the condensing surfaces and some of the equipment serving to generate cold. The disadvantage of this known regeneration cycle is that a relatively long period of time is required for carrying it out.

The object of the present invention is to provide a cryopump having means for regenerating the condensing surfaces, with which pump regeneration can be carried out in a considerably shorter time than in the case of the known cryopumps.

According to the invention, this object is achieved by a cryopump which comprises condensing surfaces and at least one heating wire is provided directly on the immediate vicinity of the condensing surfaces for regenerating the latter. In a cryopump designed in this manner, regeneration of the condensing surfaces can be carried out *in situ* at a raised temperature. Since only the condensing surfaces have to be heated up and thereafter cooled down during a regeneration cycle, the heating and cooling times can be kept very short, so that the regeneration cycle as a whole is of optimum brevity.

The invention offers considerable advantages particularly in the case of cryopumps powered by cryogenic refrigerators. If, for example, the refrigerator is of two-stage construction and the condensing surfaces are connected to the cooling head of the refrigerator that forms the second stage, then regeneration can be carried out while the refrigerator is operating. The heating means used for warming up the condensing surfaces is fitted either on the cooling head or on the surfaces themselves. The heating capacity must be such that it is able to bring the condensing surfaces to the required raised temperature while the refrigerator is operating. The surfaces then release the frozen-on or adsorbed gases. After the heating means has been switched off, the condensing surfaces very quickly reach their required low temperature again. An important role is played in this system by the fact that, under the temperature conditions occurring during a regeneration cycle, very high thermal resistance exists between the second stage and the first stage of the refrigerator. The first stage is therefore influenced to only a slight extent by the heating up of the second stage, so that when the heating means is switched off, the full cooling capacity rapidly becomes available again.

The accompanying drawings illustrate in schematic form a cryopump according to an embodiment of the present invention.

Referring to the drawing, the illustrated cryopump has a housing 1 with an inlet opening 2 communicating with a container (not shown) from which the gases are to be pumped away. A two-stage refrigerator 3 projects upwardly into the housing 1. Mounted on the first stage 4 of the refrigerator 3 to give good thermal conductivity is a further, substantially cup-shaped housing 5 which serves mainly for screening purposes; the opening 6 of this housing 5 that is substantially parallel with the opening 2 of the housing 1 is covered with metal angled members 7 which likewise serve to provide a screening effect. The second stage 8 of the refrigerator 3 projects upwardly into the cup-shaped housing 5 and there forms a cooling head 9, which carries the condensing surfaces 10. To increase the surface and to intensify the pumping off of light gases, the condensing surfaces 10 are covered with an adsorption material 11. The shape of the surfaces 10 will not be described in detail since the same does not form the subject-matter of the invention.

According to the invention, either the condensing surfaces 10 themselves or the cooling head 9 are or is provided with a heating means preferably consisting of wires. In the illustrated

embodiment, at least one electrical resistance heating wire 12 is soldered on to the condensing surfaces 10 in the region of the cooling head 9 and leads 13 extending through the housings 5 and 1 are provided to supply current to the wire 12. When the current is switched on, the condensing surfaces 10 are caused to warm up so that they release the gases frozen or adsorbed thereon. Since as known high thermal resistance exists between the first stage 4 and the second stage 8 of the refrigerator, the latter does not need to be switched off. The gases evaporated or dissoved from the condensing surfaces 10 are pumped off by a fore-pump, not illustrated, which likewise remains in operation. The connection with the container remains advantageously uninterrupted during the regeneration cycle. Instead of mounting the wire 12 directly on the condensing surfaces 10, it can be supported in the immediate vicinity of the same.

Claims

1. A cryopump which comprises condensing surfaces and at least one heating wire is provided directly on the immediate vicinity of the condensing surfaces for regenerating the latter.

2. A cryopump according to Claim 1, wherein the condensing surfaces are mounted on a cooling head and the at least one heating wire is arranged in the region of the cooling head.

3. A cryopump according to Claim 1 or Claim 2, further comprising a two-stage cryogenic refrigerator, the second stage of which is designed as the cooling head.

4. A method of regenerating a cryopump powered by a two-stage cryogenic refrigerator, wherein the pump comprises condensing surfaces in good heat-conducting communication with the second stage of the refrigerator, characterized in that the heat necessary for regenerating the condensing surfaces is produced only in the region of the second stage of the refrigerator.

5. A cryopump substantially as hereinbefore described with reference to the accompanying drawing.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1981. Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.